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Downey et al.

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(54) **SUPPORT ARRANGEMENTS FOR WATER TREATMENT TANK**

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Related U.S. Application Data

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(51) **Int. Cl.**

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B65D 88/12	(2006.01)
B65D 1/40	(2006.01)
B65D 90/08	(2006.01)
B65D 90/02	(2006.01)

(52) **U.S. Cl.**

CPC .. ***B65D 1/40*** (2013.01); ***B65D 7/38*** (2013.01); ***B65D 90/022*** (2013.01); ***B65D 90/08*** (2013.01); *B65D 88/121* (2013.01)

(58) **Field of Classification Search**

CPC B65D 6/32; B65D 88/12
USPC 220/565, 562, 1.5, 670, 4.12; 206/335
See application file for complete search history.

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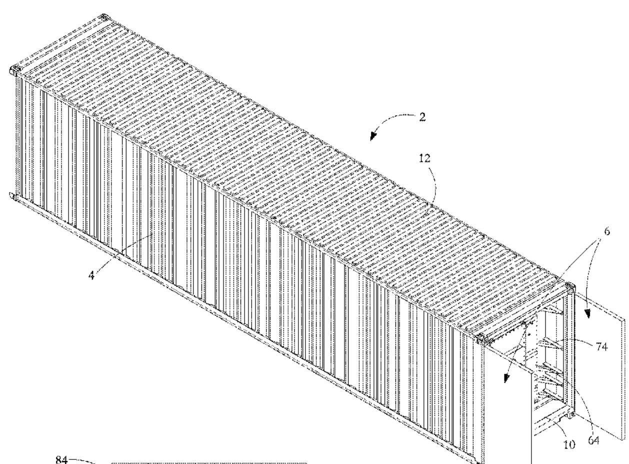
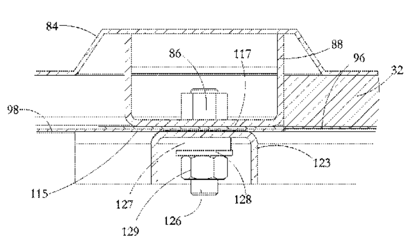
(57) **ABSTRACT**

A tank for processing wastewater has reinforced side and end walls, a top wall and a floor. A flexible liner is mounted inside the tank. Regions of the top wall have reinforcing elements fixed thereto. The reinforcing elements have fixture elements integral therewith for suspending and supporting items in the interior of the tank.

11 Claims, 15 Drawing Sheets





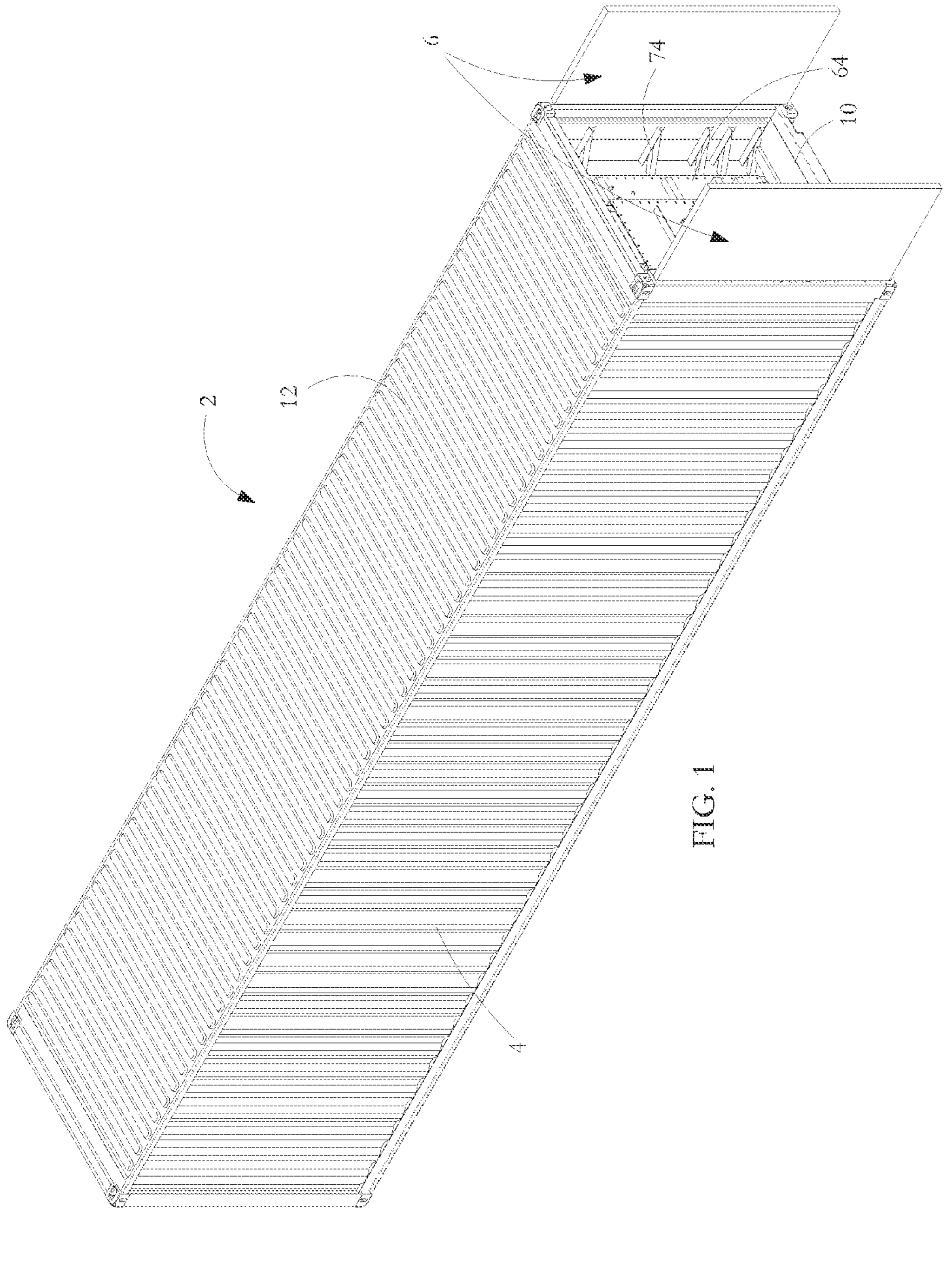


FIG. 1

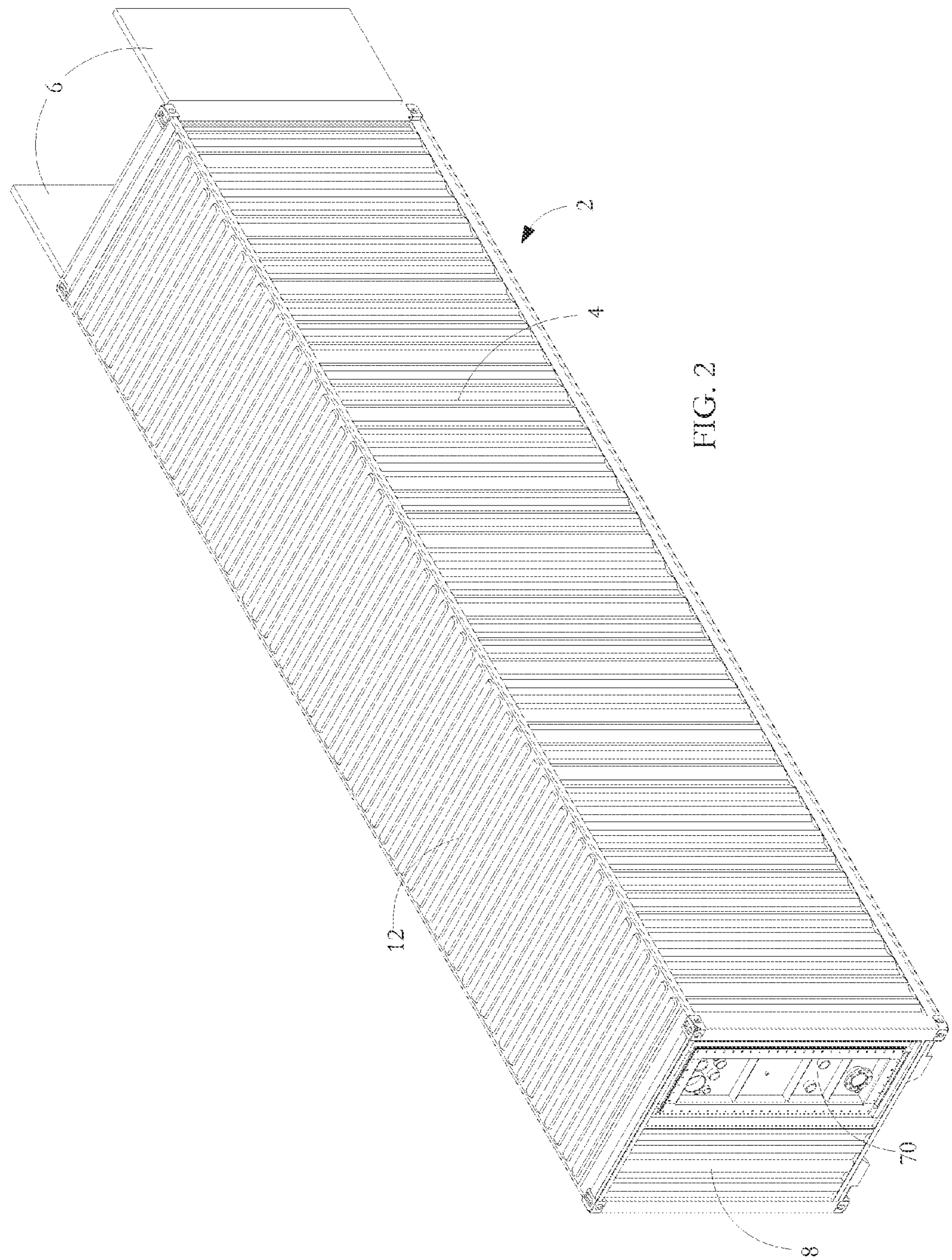


FIG. 2

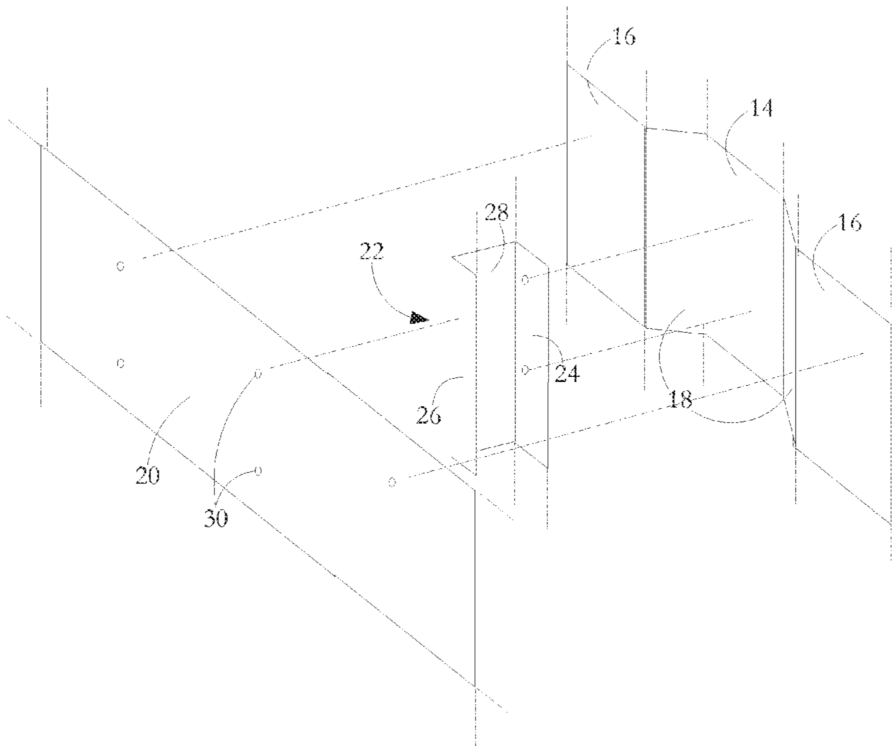


FIG. 3

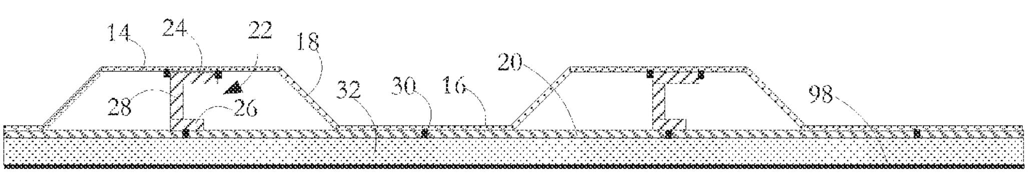


FIG. 4

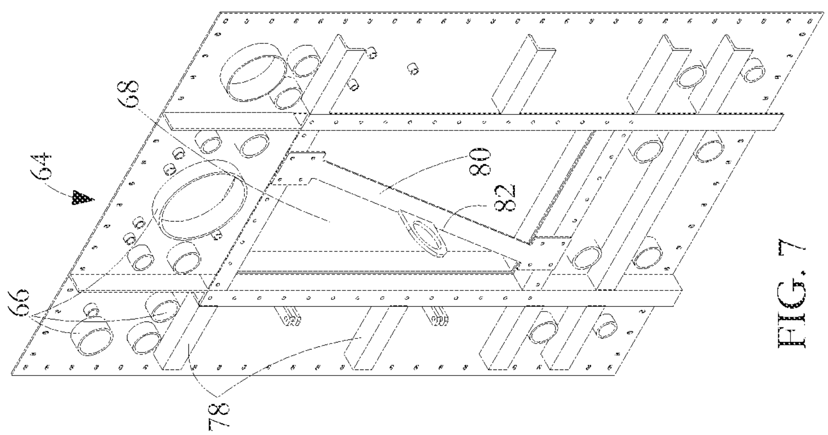


FIG. 7

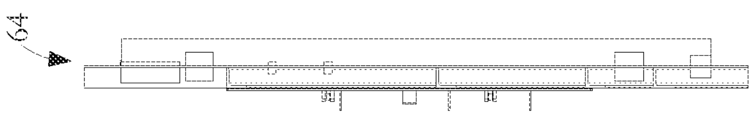


FIG. 6

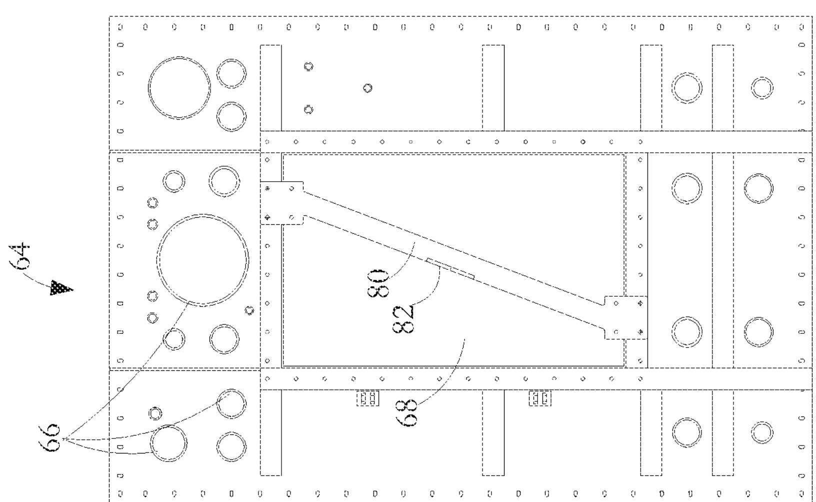


FIG. 5

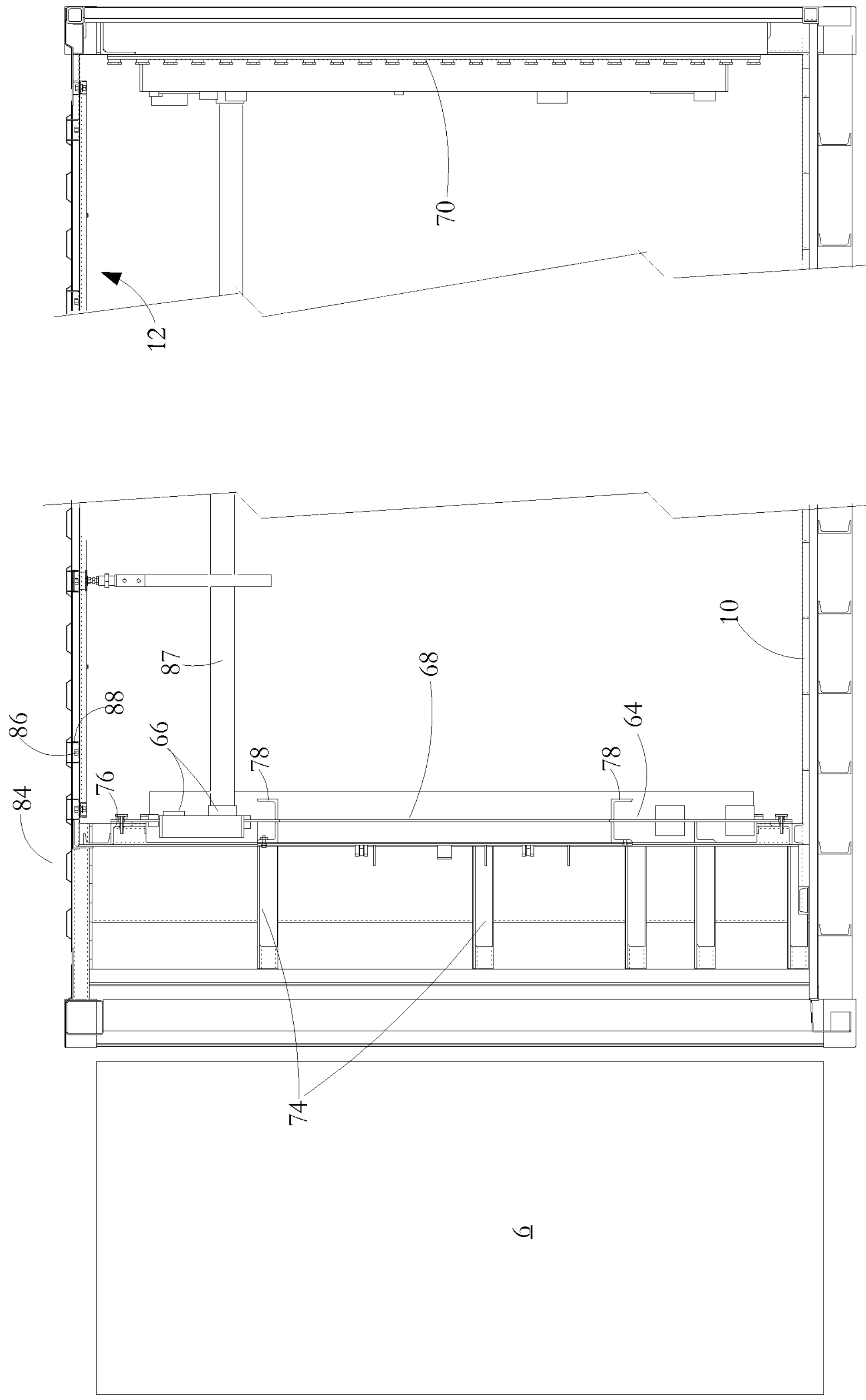


FIG. 8

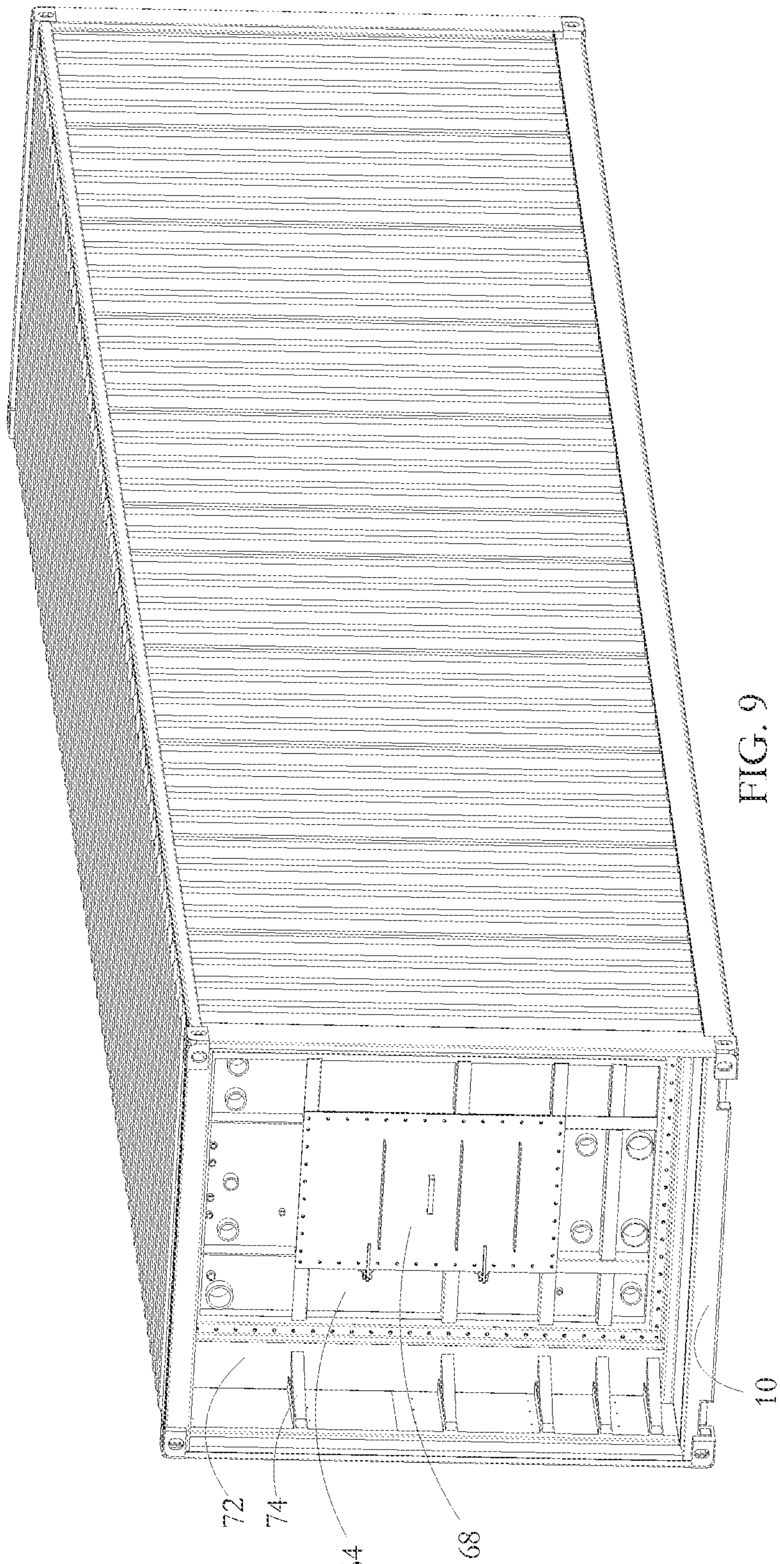


FIG. 9

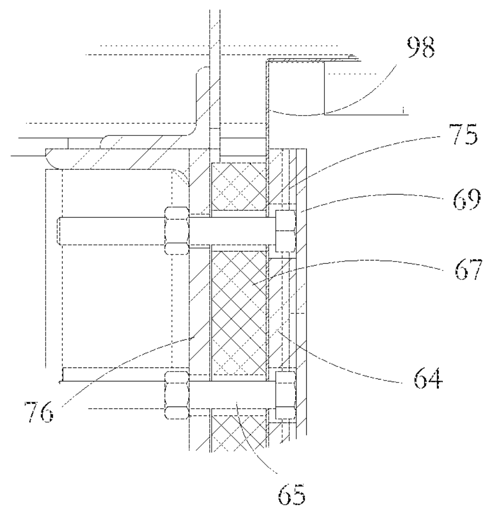


FIG. 10

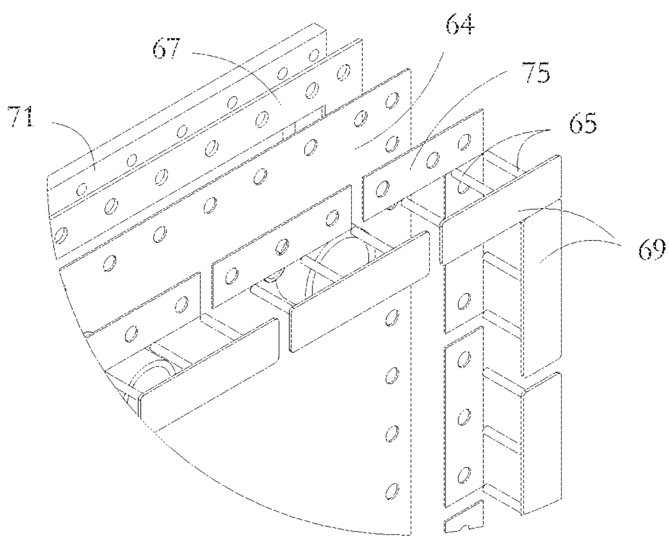


FIG. 11

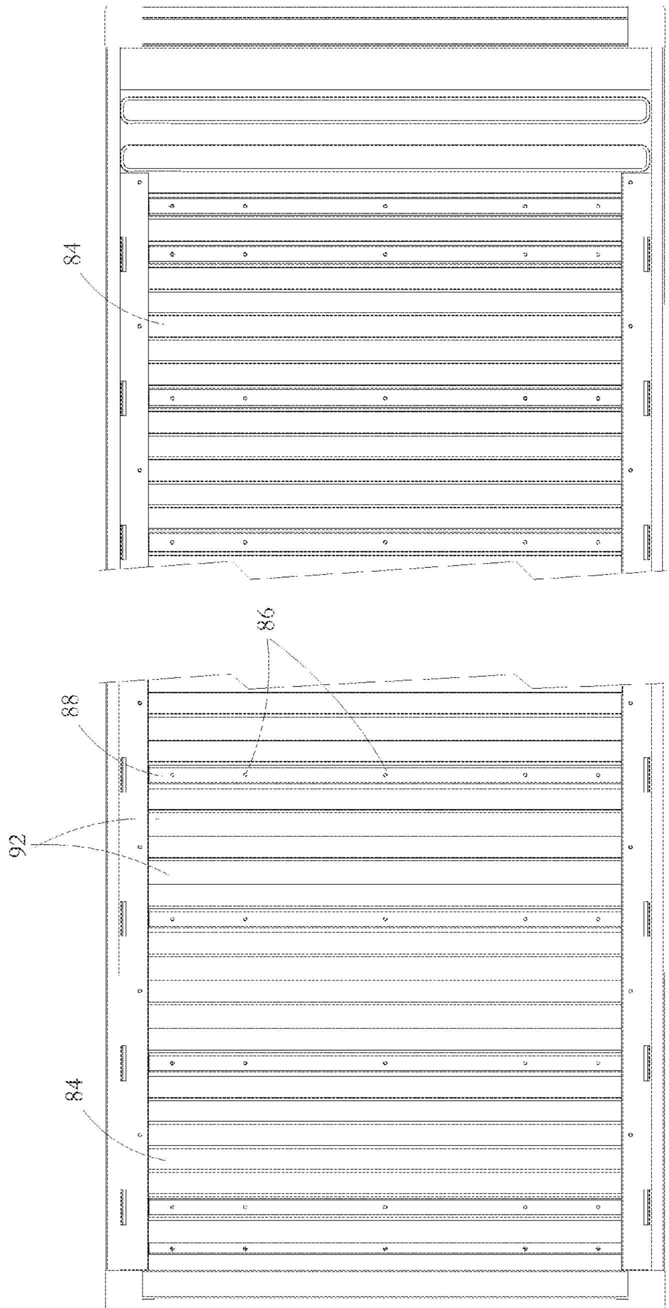


FIG. 12

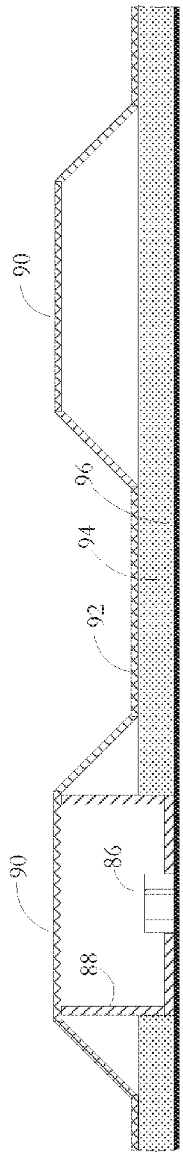


FIG. 13

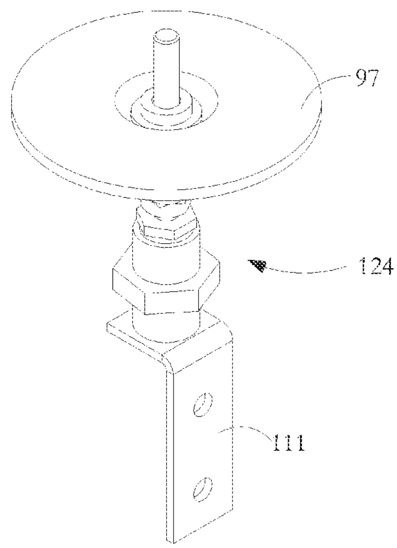


FIG. 14

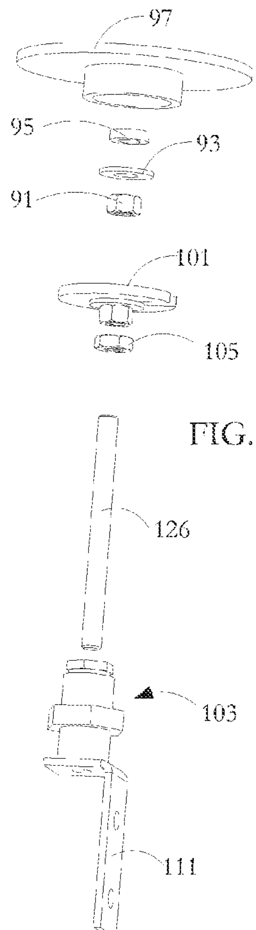


FIG. 15

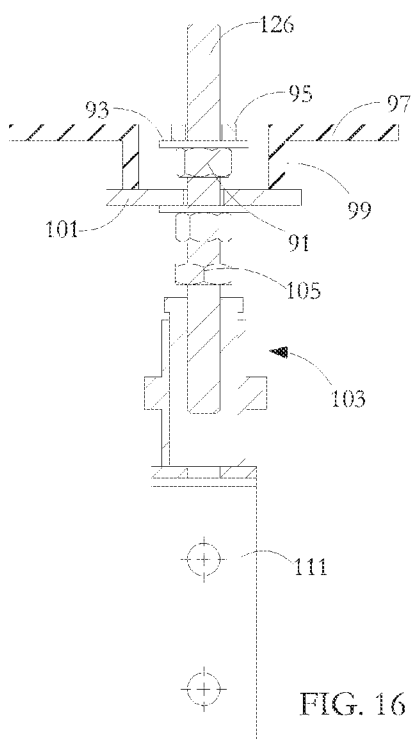


FIG. 16

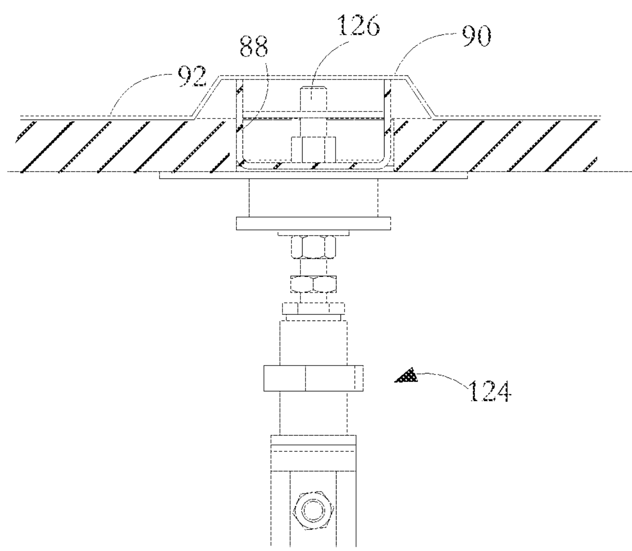


FIG. 17

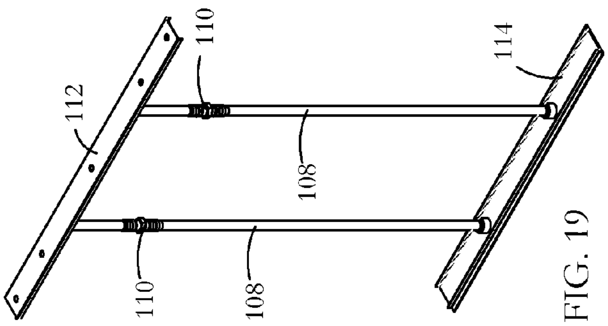


FIG. 19

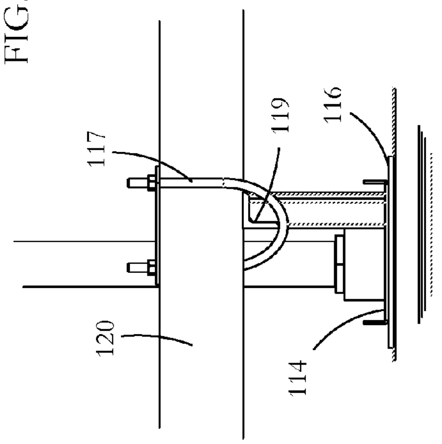


FIG. 20

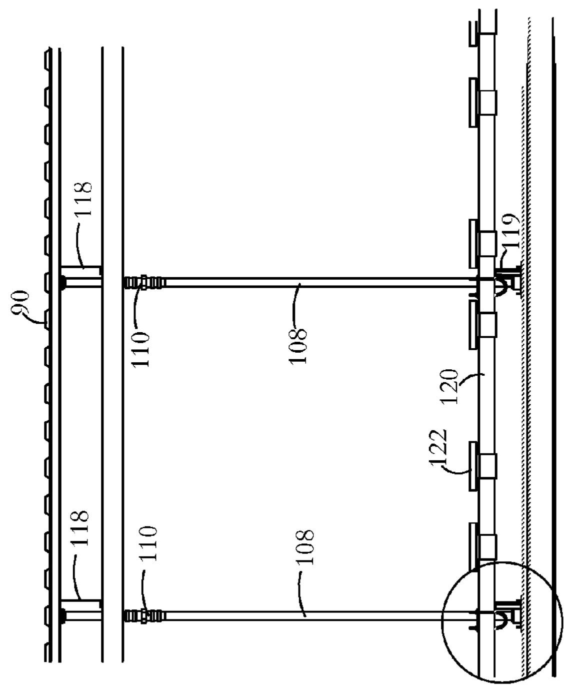


FIG. 18

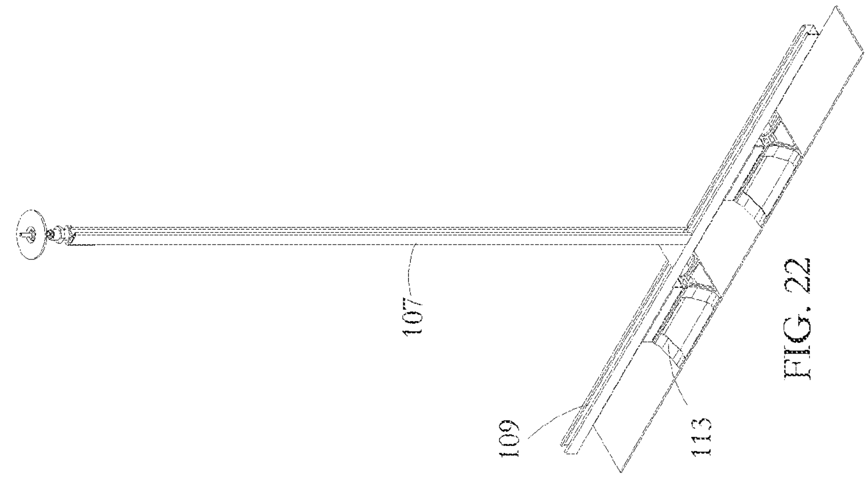


FIG. 22

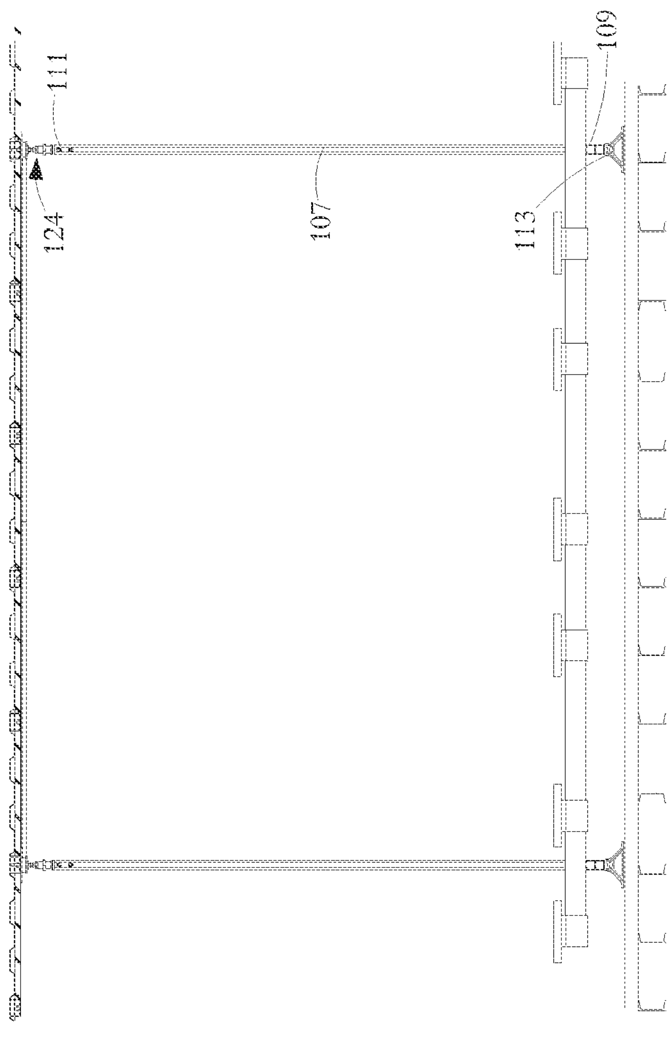


FIG. 21

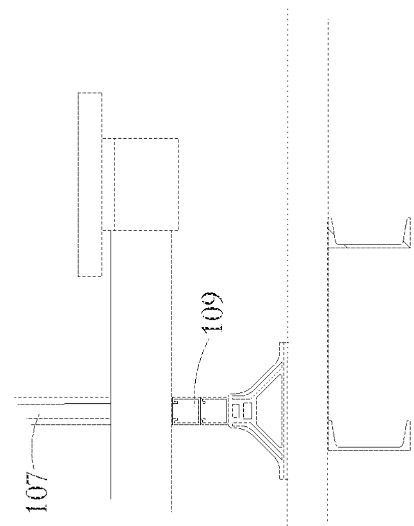


FIG. 24

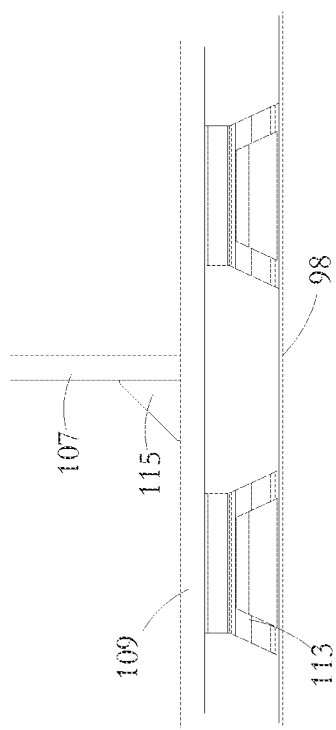


FIG. 23

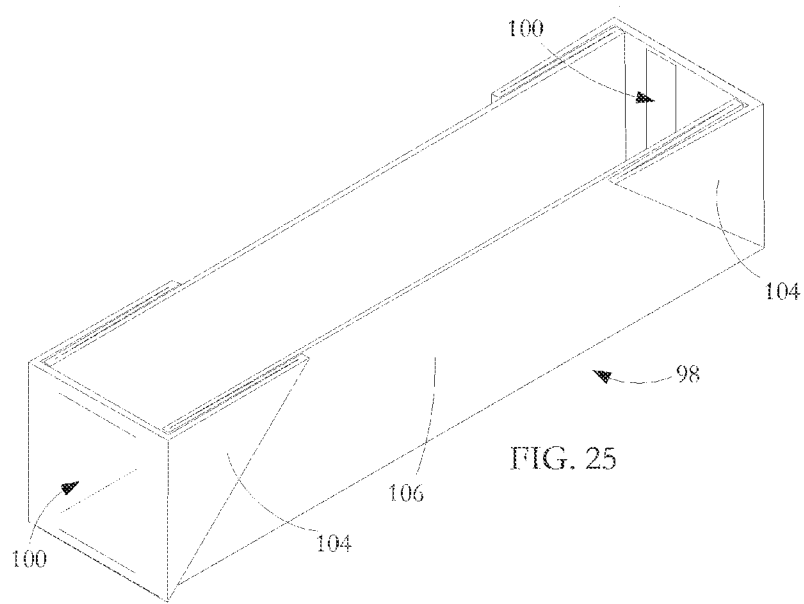


FIG. 25

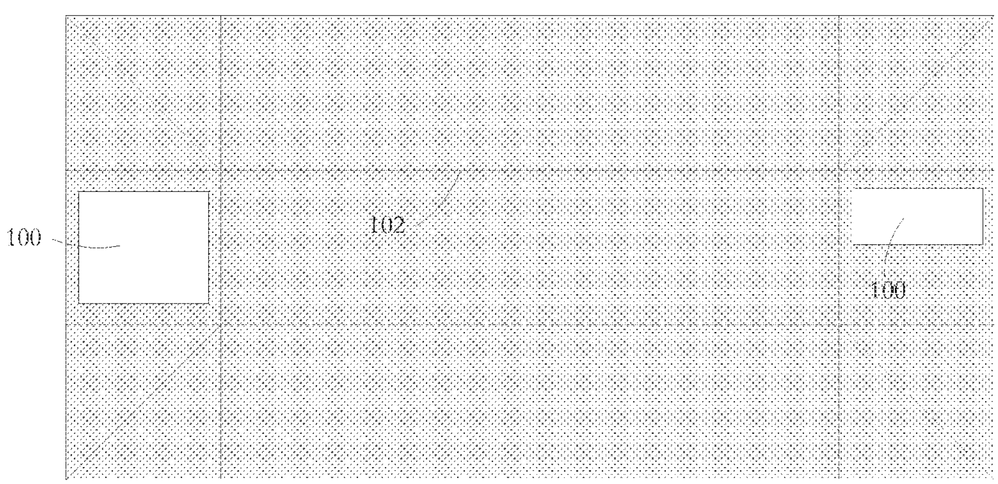


FIG. 26

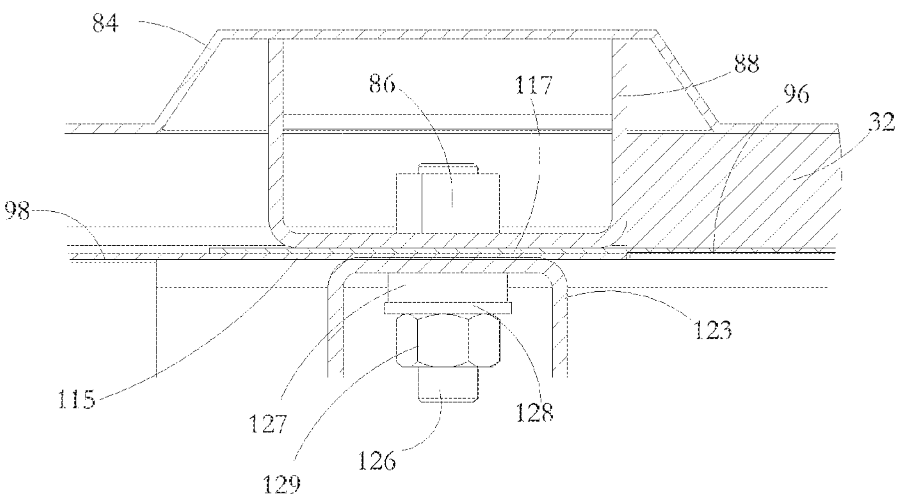


FIG. 27

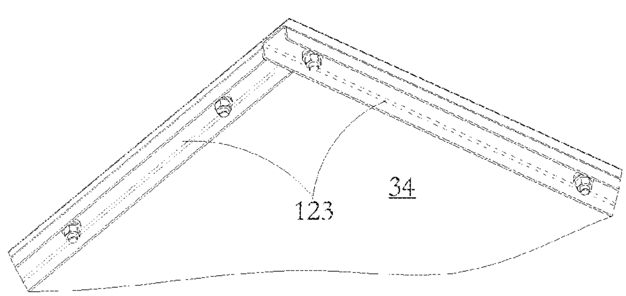


FIG. 28

SUPPORT ARRANGEMENTS FOR WATER TREATMENT TANK

CROSS REFERENCE TO RELATED PATENTS

The present application claims priority under 35 USC 119 (e) to provisionally filed U.S. Application entitled "Container conversion for water treatment tank", having Ser. No. 61/762,968, and filed on Feb. 11, 2013, the contents of which are expressly incorporated herein in their entirety by reference thereto. The present application further claims priority under 35 USC 119(e) to provisionally filed U.S. Application entitled "Method of reinforcing an intermodal container and container so reinforced", having Ser. No. 61/875,267, and filed on Sep. 9, 2013, the contents of which are expressly incorporated herein in their entirety by reference thereto.

FIELD OF THE INVENTION

This invention relates to support arrangements for water treatment tanks and has particular application to converted intermodal containers for use as wastewater treatment tanks.

DESCRIPTION OF RELATED ART

Water tanks are needed for a variety of purposes in the context of wastewater treatment. Holding tanks are used for storing water before or after it is treated. Equalization tanks are used in processes for dampening large variations in water flow rate or quality. Aeration tanks are used for stimulating aerobic breakdown of contaminants in wastewater. Membrane bioreactor (MBR) tanks are used to remove contaminants during or after aeration. Settling tanks are used to remove heavier than water solids. Filtration tanks are used for filtering wastewater. Air/water tanks, in which countercurrents of air and water are flow over packing material, are used for air stripping of volatile contaminants or for cooling and evaporation.

There is a requirement for easily portable tanks that can be partly or fully pre-fabricated and shipped to deployment sites. The requirement for transporting in conventional intermodal container sizes places limitations on the length, footprint area and height of prefabricated mobile units. It has been proposed that an intermodal container itself be used in the manufacture of a water treatment tank. A typical intermodal container (also called shipping container, freight container, ISO container, hi-cube container, box, conex box and sea can) is a standardized reusable steel box used for the storage and movement of materials and products within a global containerized intermodal freight transport system. External lengths of containers, which each have a unique ISO 6346 reporting mark, vary from 8 feet (2.438 m) to 56 feet (17.07 m) with the most common lengths being 20 feet and 40 feet. Heights of containers compliant with ISO 6346 are from 8 feet (2.438 m) to 9 feet 6 inches (2.9 m). Widths are generally 8 feet.

It would be valuable to have support arrangements for use in converted intermodal containers used as water treatment tanks where the principles and structures of such support arrangements can also be implemented in tanks which are not based on intermodal container conversions.

BRIEF DESCRIPTION OF THE DRAWINGS

For simplicity and clarity of illustration, elements illustrated in the following figures are not drawn to common scale. For example, the dimensions of some of the elements are exaggerated relative to other elements for clarity. Advantages, features and characteristics of the present invention, as well as methods, operation and functions of related elements of structure, and the combinations of parts and economies of manufacture, will become apparent upon consideration of the following description and claims with reference to the accompanying drawings, all of which form a part of the specification, wherein like reference numerals designate corresponding parts in the various figures, and wherein:

FIG. **1** is an isometric view from the front and one side of a converted intermodal container according to an embodiment of the invention.

FIG. **2** is an isometric view from the rear and the other side of the converted intermodal container of FIG. **1**.

FIG. **3** is an exploded isometric view of part of a reinforcing arrangement according to an embodiment of the invention and used in a converted intermodal container.

FIG. **4** is a horizontal sectional view of the reinforcing arrangement of FIG. **3**.

FIG. **5** is a front view of a process wall for installation in a reinforced intermodal container end wall according to an embodiment of the invention.

FIG. **6** is a side view of the process wall of FIG. **5**.

FIG. **7** is an isometric view of the process wall of FIG. **5**.

FIG. **8** is a vertical sectional view through a reinforced intermodal container showing, according to an embodiment of the invention, a process wall arrangement at one end of the container and a hatch arrangement at the other end of the container.

FIG. **9** is an isometric view of the process wall of FIG. **5** showing the process wall installed at one end of a reinforced intermodal container according to an embodiment of the invention.

FIG. **10** is scrap sectional view showing the manner of attachment of the process wall in the reinforced intermodal container according to an embodiment of the invention.

FIG. **11** is a detail exploded view showing the manner of attachment of the process wall in the reinforced intermodal container according to an embodiment of the invention.

FIG. **12** is a view from below of the roof of a reinforced intermodal container showing a component suspension arrangement according to an embodiment of the invention.

FIG. **13** is a detail vertical sectional view showing a part of the roof and component suspension arrangement of FIG. **12**.

FIG. **14** is an isometric view of part of a lower part of a suspension assembly according to an embodiment of the invention.

FIG. **15** is an exploded isometric view showing elements of the suspension assembly part of FIG. **14**.

FIG. **16** is a vertical sectional view of the suspension assembly part of FIG. **14**.

FIG. **17** is a part section view of a suspension assembly according to an embodiment of the invention.

FIG. **19** is an isometric view of elements of a suspension system according to an embodiment of the invention for supporting utility and process elements in the interior of a reinforced intermodal container.

FIG. **18** is a side view of part of a suspension system as deployed in a reinforced intermodal container and using the elements illustrated in FIG. **19**.

FIG. **20** is a detail view to a larger scale of part of the suspension system of FIG. **18**.

FIG. **21** is a side view of another form of a converted intermodal container support arrangement according to an embodiment of the invention.

FIG. **22** is an isometric view of part of the support arrangement of FIG. **21**.

FIG. **23** is a detail view of the base of the support arrangement of FIG. **21** from one end.

FIG. **24** is a detail view of the base of the support arrangement of FIG. **21** from one side.

FIG. **25** is an isometric view of a flexible liner according to an embodiment of the invention, the liner for use in a reinforced intermodal container.

FIG. **26** is a plan view of a stock flexible liner material blank for use in making the liner of FIG. **25**.

FIG. **27** is a detail sectional view showing a join configuration between a liner tub part and a liner cap part, the liner parts together forming a liner for a converted intermodal container according to an embodiment of the invention.

FIG. **28** is detail isometric view from below of the join configuration of FIG. **27**.

DETAILED DESCRIPTION OF THE INVENTION INCLUDING THE PRESENTLY PREFERRED EMBODIMENTS

As shown in the isometric illustrations of a reinforced intermodal container **2** in FIGS. **1** and **2**, the container is basically a box made from weathering sheet steel having side walls **4**, a front door wall **6**, a rear wall **8**, a floor **10** and a roof **12**. Such containers are also known as shipping or freight containers and are conventionally used for the storage and movement of materials and products within a global containerized intermodal freight transport system. "Intermodal" indicates that the container can be moved from one mode of transport to another (e.g. from ship, to rail, to truck) without unloading and reloading the contents of the container.

Under the ISO 6346 standard, the length of a container may be any of a range of external lengths each corresponding to an ISO 6346 reporting mark. Such lengths may vary from 8 feet (2.438 m) to 56 feet (17.07 m) with the most common lengths being 20 feet and 40 feet. Heights of containers compliant with ISO 6346 are from 8 feet (2.438 m) to 9 feet 6 inches (2.9 m). Widths are generally 8 feet.

As shown in the detail isometric view of FIG. **3** and the detail sectional view of FIG. **4**, container walls are made of corrugated weathering sheet steel having a thickness of the order of a sixteenth of an inch. The walls have in sequence along their length, alternating outboard and inboard panels, respectively **14** and **16**, each outboard panel integrally joined to its adjacent inboard panels by sloping web portions. The panels extend from the bottom to the top of the intermodal container. While the corrugated wall formation provides some strength against lateral and vertical forces, if an unreinforced container is filled with water, the corrugation simply expands like an accordion. The walls are then incapable of offering resistance to the lateral forces imposed by the contained water and the container will consequently bow outwards and burst. FIGS. **3** and **4** show one configuration for reinforcing a container wall so that the container may be used for processing water or other liquids.

Referring in detail to FIGS. **3** and **4**, there is shown part of the wall of a reinforced intermodal container. The wall is reinforced by welding a reinforcing structure to the inside of the wall, the reinforcing structure including a sheet steel panel **20** having a thickness of the order of one eighth of an inch and channel form stiffeners **22** made of cold-formed steel plate of the order of a three sixteenths of an inch in material thickness. The channel member **22** has walls **24**, **26** bridged by flange **28**. The channel members **22** are welded to each outboard panel **14** with a wall **24** of each channel member flat against the interior surface of an outboard panel **14** of the container wall. The width of flange **28** is such that the walls **26** and the inboard panels **16** of the corrugated container wall are essentially coplanar and so form a platform to which the sheet steel panel **20** is fixed. The sheet steel panel **20** is welded to the walls **26** of the channel members **22** after the channel members have been welded to the outside panels and is also welded to the interior surfaces of the inboard panels **16**. Walls **24** of the channel members **22** extend further from the respective flanges **28** than walls **26**. The disparity in height of the two channel member walls **24**, **26** facilitates bending in the course of a cold forming process for manufacturing the channel members **22**. Having the high wall **24** positioned against the outboard panel **14** strengthens the outboard panel and also makes it easier to weld because the presence of the smaller wall **26** does not materially inhibit access when the wall **24** is being welded to the outboard panel **14**.

Each channel form stiffener is welded in a position laterally at the center of the associated outboard panel **14** by means of a fillet weld at its base and a series of button or plug welds through spaced 5⁄16" diameter circular apertures in walls **24** of the channel members. The sheet steel panel is welded to the channel members **22**, the inboard panels **16** and the floor by fillet welds at the bottom of the panel. The panel is welded through its height by a series of button welds made at quarter inch diameter circular apertures **30** in the panel **20**, the button welds spaced from the floor by distances of 12, 30, 54, 78 and 102 inches, the smaller spacing at the bottom being to combat higher stresses at the bottom of the container when it is full. Button welds are a valuable structural element of the intermodal container conversion because they provide a controllable technique offering good penetration to the corrugated container wall while providing a reduced risk of burn damage compared with other welding techniques. The preferred welding process is MIG welding in spray mode with a 0.035 mm metal core wire, a Praxair® MIG Mix Gold™ Gas (argon/CO2 mix), a 350 wire feed speed, and 24V setting. These conditions consistently provide a full penetration weld without burning through the outside wall. Clearly, different welding techniques and materials can be utilized to achieve wall reinforcement using the panels **20** and channel members **22** as described. It is desirable however, to use a process and materials to obtain a strong welding pattern quickly and without burning through the outer wall of the intermodal container.

For supply convenience, the sheet steel panel **20** is formed from two panels each 4 feet in width laid on edge so that together they span an eight foot height. Spacing between edges of adjacent areas of steel panel, whether horizontal or vertical, is made as small as possible and certainly less than 2 inches. This is important because when the intermodal container is used as a liquid container, for some installations, an inch thick insulating polystyrene layer **32** is often fixed by adhesive to the inner face of the reinforcing sheet steel panels and then a flexible, liquid-tight liner **34** is arranged over and secured by adhesive foam caulking to the insulating layer **32**. The pressure of liquid in a full tank or container is so high that if the gap between adjacent sections steel panel **20** is too large, the pressure of the contained liquid would deform and press the liner **34** and insulating layer **32** into the gap and possibly damage one or both of the liner and insulation.

It will be seen that the method for reinforcing an intermodal container wall adds strengthening material only to the inside of the container, with the outside dimensions of the container remaining unchanged after the reinforcing is complete. This means that, after reinforcing, the container continues to meet the outside dimensional requirements of the ISO 6346 standard for that length of container. The internal width of the container wall is reduced by only a small amount. The illustrated strengthening structure has flanges extending at substantially 90 degrees to the general plane of the intermodal container wall, the flanges joining outboard container panels to inboard flat members which are joined to the inboard container panels. Compared to the unreinforced walls, this container wall structure is considerably less prone to bending when the container is filled with water. It will be appreciated that the reinforcing structure can be altered somewhat without compromising the reinforcing properties and while using the principles inherent in the illustrated design.

As indicated previously, a converted intermodal container is used as a processing tank for storing or treating water. Processing may take any of a number of forms depending on the nature of the untreated water input and the desired nature of the treated water output. Such processing predominantly occurs inside the tank but requires inputs to the tank and outputs from the tank. In one embodiment of the invention, as illustrated in FIGS. **5** to **7**, interface components for the tank inputs and outputs are mounted and sealed at ports in a process wall **64**. The inputs and outputs include, but are not limited to, any of air lines, visual and electronic monitoring, cleaning ports, motors, sensors, power sources, power cables, communication cables, piping, viewing access, sampling access, vent access, solid effluent extractor, and access hatches. Particularly for servicing processing equipment below the design level of water to be processed in the container tank, the ports are located at a lower level in the process wall. Particularly for routing communication and power cables, ports are located at a process wall upper level. In this specification, components that are used in water processing and need an interface with the water being stored or treated are generally referred to as process components. Components that are used in providing communication and power to the tank interior are generally referred to as utility components.

Referring in detail to FIGS. **5** to **7**, the process wall **64** is located at the front end of the converted container tank, where water to be treated enters the tank. A corresponding process wall is sited where treated water exits the tank at the back wall of the tank. This arrangement is convenient for plants in which several container tanks are deployed as a "train" with each tank functioning as one module of the site processing operations. Communication/power cabling and piping run into the front end and out of the back end of an upstream container tank so that downstream tanks in the train can be serviced by common systems. It will be appreciated that a process wall or walls can be installed at other locations such as the top wall of the container tank. Furthermore, whereas in a train of tanks, it may be convenient to site process and utility components at separate input and output process walls, inputs and outputs for a particular processing equipment can alternatively be located at a single process wall, with the associated processing equipment configured as a circuit in the container tank.

The process wall **64** of FIGS. **5** to **7** is designed to be installed near the front end of the container tank as shown in FIGS. **8** and **9**. The process wall **64** has side panels, a hinged, outwardly swinging manual access hatch **68**, and ports **66** to enable mounting of components forming elements of the servicing and processing sub-systems. At the rear end of the container, an area of the end wall **8** is used for accommodating corresponding components for "through" services and for providing a rear manual access hatch **70**. A standard intermodal container is modified as illustrated with respect to FIG. **8** to enable attachment of the process wall **64**. The standard container has two floor-to-roof doors **6** in its front end enabling loading and unloading of the container. In the modified intermodal container shown in FIG. **9**, stub walls **72** are welded to the container side walls, floor and roof (also called a top wall) to create a bulkhead structure about 12 inches along the container sidewall from the doors **6**. The junction of the stub walls **72** with the container side walls **4** are strengthened by compression ties **74**. The bulkhead structure defines a process wall aperture at which a flange **76** faces into the interior of the container tank, the flange having bolt holes for attachment of the process wall. The process wall has an edge region having bolt holes for alignment with holes in the flange to enable the process wall to be bolted to the flange using outwardly extending bolts **65**. The process wall **64** is made from quarter inch thick carbon steel or eighth inch thick stainless steel and has angle bar strengthening as shown at **78** to combat pressure of water in the filled container tank. It is set in place from inside the container tank. The process wall **64** can be removed as a single structure to enable access to the interior of the tank, when emptied, for repair and servicing if such repair and servicing cannot satisfactorily be achieved using the access hatch **68**.

It is important that the flexible liner **34**, to be described in detail presently, is effectively sealed, both over the full extent of the liner and where the liner tub part terminates at the process wall **64**. The latter is achieved by sandwiching a perimeter strip of the liner between the process wall **64** and the flange **76**. As can be seen in the scrap views of FIGS. **10** and **11**, the mounting for the process wall **64** is designed with the object of preventing leakage from the container tank. On the inside of the process wall **64** are a gasket **67** and, optionally, a paired one inch thick polypropylene spacer **71** and polyvinyl chloride sheet outside liner **73**. The optional secondary liner **73** is installed against the container walls and provides secondary leakage protection for the tank in the event the polypropylene liner **34** were to fail as a result, for example, of the liner being accidentally punctured. The spacer **71** provides one inch of insulation between the inner and outer liners **34**, **73** in those installations where there is such an outer liner. With the foam spacer layer **71** and the polyvinyl chloride sheet secondary liner **73**, the chance of water leakage to the outside of the converted container is minimized. On the outside of the process wall **64** are a gasket **75** and series of protective steel plates **69**, the backs of which are welded to the heads of underlying bolts **65**, the plates **69** acting to prevent leakage through the bolt thread connections.

Referring back to FIGS. **5** to **7**, to enable easy installation of the process wall **64**, a diagonally extending bar **80** is attached to the outside of the process wall with a hook **82** at the balance point of the wall. This enables the process wall **64** to be suspended by a crane arm, carried into the interior of the container tank, and then manually manoeuvered into a position where it can be bolted into place without the need to expend significant force. It is important that the process wall is manoeuvered without tearing the flexible liner **34** which would be a risk if the wall has to be moved by manual lifters working inside the container tank. An aperture in the rear wall **8** is similarly configured with a flange to allow installation in a similar manner of a smaller process wall containing an inspection hatch and service/process components.

Certain processing equipment may, in operation, be immersed in the tank water and for such processing equipment, associated process components such as sensors and inspection ports may be mounted at a process level so that they interface with the water in the tank. Other services such as communication and power do not need a direct interface with the contained water and are mounted away from the water contained in the tank.

Processing of water in the tank may be any of a number of forms depending on the nature of the untreated water input and the desired nature of the treated water output. Processing equipment in the tank interior may include, but is not limited to, any of bubbling equipment, scrubbing equipment, clarifying equipment, stripping equipment and mixing equipment, although it will be understood that a converted intermodal container according to one embodiment of the invention can be used simply for water storage in which case there may be no interior processing equipment. The equipment may include, but is not limited to, any of units and/or structures such as submersible pumps, stripping packing media, tubular media for clarification, air bubblers, venture mixers, diffuser piping, distributors and platforms for supporting packing. In known heavy duty carbon steel tanks, the processing equipment is supported on heavy duty support members that are welded to the tank walls. In the present invention, because a flexible liner is used, welding interior supports to the fabric of the tank is not acceptable because it would require the liner to be punctured at a number of places with some of the puncture sites being below the design level of water to be stored or processed in the tank. This, in turn, would require expensive sealing arrangements and would entail a high risk of leakage. It is important that the flexible liner is not punctured either during manufacture of the tank or, later, during provisioning, transport and deployment for water treatment.

Various embodiments of support arrangements are shown in FIGS. **12** to **24**. Each of the support arrangements includes a suspension assembly **124** as shown in greater detail in FIGS. **12** to **17**. The assemblies **124** are used without material adaptation or addition to suspend relatively lightweight components such as communication and power cables. The suspension assemblies are also used, in combination with support assemblies which engage the floor of the converted intermodal container tank, to support heavy processing equipment within the water. Embodiments of such heavy duty support arrangements are illustrated in FIGS. **18-24**.

Referring in detail to FIGS. **12** and **13**, there is shown the roof **12** of a converted intermodal container, the roof formed with a stamped pattern of corrugations **84**. Nuts **86** are welded into apertures formed in reinforcing channel bars **88** and the bars are then welded at locations to outboard panels **90** of a number of the corrugations. The reinforcing bars **88** and the nuts **86** are dimensioned and fitted so that they project one inch downwardly beyond the plane occupied by the inner surfaces of inboard corrugation panels **92** of the container roof **12**. By fitting the reinforcements at the outboard panels **90**, strong joists are provided without materially affecting the inside intermodal container shipping height. One inch thick insulation **32** is then applied to the roof **12** except at the positions of the reinforcing bars **88** to bring the roof to a common level for subsequent application of a liner cap part **96**. The reinforcing bars **88** act as strengthening joists at the roof with the threaded bores of the suspension nuts **86** providing anchor points for receiving threaded suspension bolts **126** as shown in FIGS. **14-17**.

While other forms of reinforcing element can be welded to the top wall of the intermodal container, the channel bar **88** illustrated is preferred as it extends across the full length of the container top wall enabling the positioning of a suspension assembly at any position across the width of the tank. Also, a bar **88** can be placed in any selected "up" corrugation enabling the positioning of a suspension assembly at substantially any desired position along the length of the converted intermodal container tank.

In each suspension assembly as shown in FIGS. **14** to **17**, a suspension bolt **126** is first screwed up into, and anchored at, one of the nuts **86**. The nut and bolt combinations can be configured to provide any of several functions. Firstly, they can be part of suspension assemblies **124** used for supporting heavy processing equipment at selected locations and depths in the tank. Secondly, they can be part of suspension assemblies including brackets tailored for supporting relatively lightweight components such as communication and power cabling, piping, etc., within a top region of the intermodal container. Finally, some of the nut **86** and bolt **126** combinations provide a securing mechanism for use in making a seal between a liner tub part **98** and a liner cap part **96** as will be described presently.

One form of suspension assembly **124** as illustrated in FIGS. **12** to **17** has the central bolt **126** clamped against the liner cap part **96** and the reinforcing bar **88** by a lock nut **91**, washer **93** and gasket **95**. A circular plate **97** with depending annular flange **99** is placed over the anchored bolt **126** so that the plate **97** bears against the surrounding part of the liner cap part **96** and the reinforcing bar **88**. A slotted plate **101** is slid from the side over the exposed part of the bolt **126** and is bolted against the flange **99**. A lower element of the suspension assembly has a reducing union **103**. The reducing union **103** is screwed onto the threaded stud **126** to a desired vertical position and is then locked in position with locknut **105**. The lower part of the suspension assembly **124** is adapted for use with a support arrangement, alternative forms of which are shown in FIGS. **18** to **20** and in FIGS. **21** to **24**. In use, when the union **103** is turned, it threads onto the stud **126** and moves down, applying a compressive load on the bracket **111** providing a rigid support.

As an alternative to the nuts **86**, the reinforcing bar **88** can be formed with horizontal sections of relatively increased thickness, the thicker sections being bored and internally threaded to provide direct anchor points in the reinforcing bar **88** for installation of suspension assemblies **124**. Other forms of roof fixtures for the suspension assemblies are possible. In one alternative, a spring biased clamping mechanism (not shown) can be used having an upper fixture member with spring-actuated clamping elements mounted to the reinforcing bars above an entrance aperture in the bars. The lower fixture member is a cylindrical stud having a lower threaded part and an upper wider part shaped to cooperate with the spring clamping members. At installation, the lower fixture member is pushed up through the entrance aperture to force the clamping elements apart until the stud reaches a locking position at which the clamping elements are forced back towards each other by the spring action to clamp the stud in position. The wider part of the stud can for example be the shape of a ball with the clamping elements presenting a claw-shaped holder.

A suspension assembly of the form shown in FIGS. **12** to **17** can be used to support relatively lightweight components that are housing in the interior of the tank but are above the design level of water to be contained in the tank. Examples of such lightweight components include communication and power cables which, in conventional water treatment tanks, are normally taken along the exterior of the tank. This presents a problem in converted intermodal containers if it required that the container be shipped in a state in which the outside dimensions are compliant with the relevant ISO 6346 standard.

In a converted tank according to an embodiment of the invention, the provisioned tank has a duct **87** (FIG. **8**) suspended near the top wall by a series of the suspension assemblies **124**. The duct **87** supports utilities such as communication and power cables so that the cables run from the process wall at the front of the tank, through the tank to the process wall at the other end of the tank. The duct housing prevents the utility cables from being exposed to water or vapor from the interior of the tank. If warranted the duct can have multiple internal chambers to avoid electrical interference between the cables or the cables can be run through more than one duct. When the provisioned converted intermodal container is being shipped to a deployment destination, because there are no extraneous leads on the outside of the container, it means the container is still of standard intermodal container height and therefore can be transported with other standardized containers. Moreover, the utility cable housings enable easy deployment of converted intermodal container tanks in a concatenated train for larger installations.

A suspension assembly **124** can alternatively be configured as a heavier duty structure to suspend heavier processing equipment within the tank. However, for heavy equipment which may be subjected to vibration and dynamic loads during shipping, a different support arrangement is preferred in which a compressive force is applied down through the support assembly so that the anchor point at the top wall is supplemented by a pressure engagement between the support assembly and the floor of the lined container.

One such support arrangement is illustrated in FIGS. **18-20**. The arrangement includes roof-mounted suspension assemblies as illustrated in FIGS. **12** to **17** together with several pairs of jack posts **108**, each post being fixed to a respective suspension assembly. The posts of each pair are spaced across the width of the reinforced container and the pairs may be distributed along the length of the container depending on where processing equipment is to be supported. The height of each post **108** is adjustable at a screw mechanism **110**. To protect the liner, bars **112** and **114** are located at the top and bottom respectively of the jack posts and extend across the container tank. Each top and bottom bar **112**, **114** is positioned over a deformable neoprene spacer **116**, and each top bar **112** is screwed to one of the joists **88**. The jack posts **108** and the bars **114**, **116** provide a means for mounting cross brackets, such as brackets **118**, at the top of the container, and brackets **119** at the bottom of the container. Alternative support brackets arrangements may hang directly off the jack posts and be configured and located to support any of various utility or process components at desired heights in the container. The jack post arrangement provides a stable support/suspension mechanism with the bars **112**, **114** and the neoprene spacers **116** protect the integrity of the relatively fragile liner. The utility and process components supported by the support arrangement may have elements that are routed through the container tank either above the design level of water to be stored / processed in the tank or below the design level. As an example, FIGS. **18**, **20** show a pipe **120** mounted near the bottom of the container, the pipe **120** clamped to the brackets **119** by U-bolts **117** and having a series of associated air diffusers **122**. In some circumstances, one or more of the pairs of jack posts can be replaced by a single jack post located near the center line of the container.

An alternative embodiment of support arrangement is shown in FIGS. **21-24**. A lower part of the support assembly as shown in FIGS. **23**, **24** has vertical posts **107** and laterals **109** formed of U-channel unistrut. The vertical posts **107** are bolted to angle brackets **111** which are mounted to the bottom of suspension assemblies **124**. At the bottom of the support assemblies, a pair of sturdy molded plastic stools **113** stands on the liner **98** on the tank floor. The stools are fixed at lower brackets **115** to the unistrut laterals **109**. The laterals **109** extend across the width of the tank but have their ends spaced from the sidewalls so as to minimize risk of the unistrut damaging the sidewall liner sections. It will be seen that in this heavier duty arrangement, while the same top anchor arrangement is used, the support assemblies bear at multiple locations against the floor of the container tank to provide greater stability for processing units to be supported in the tank interior.

The reinforced intermodal container with a suitable component support arrangement is adapted for use in containing and processing wastewater or other liquid using a flexible liner in the interior of the container. The liner has a liner tub part **98** within which water to be treated is to be contained when the tank is in use. An exemplary form of liner tub part **98** is illustrated in FIG. **25** and is used to make the interior of the reinforced container watertight. A suitable material for the liner is reinforced polypropylene. The liner is **45** mil thick and weighs about 300 lb. This material offers good breaking and tearing strength. The liner material also has good water vapour permeance, hydrostatic resistance, puncture resistance, ozone resistance, linear shrinkage, resistance to water absorption, and breaking and tearing strengths. The liner **98** is preformed into a tailored box form as illustrated in FIG. **25** and then inserted through the front access hatch **68** in the process wall **64** and manipulated into positioned against the interior surface of the container tank.

As shown in FIG. **26**, the liner tub part **98** is formed from a rectangle of stock material. For a typical liner tub part, the rectangle is of the order of 28 feet wide by 55 feet long. This may require factory installed seams between narrower lengths of stock material. The rectangle of stock material is cut to form apertures **100** for the front and rear process walls. The material is folded upwardly from a base section at lines **102** where the material has previously been tooled to facilitate and localize folding. Excess material at each corner is formed as an envelope fold **104** which is folded back along the outer sides **106** of the box form and sealed against them. Although not shown in FIG. **26**, at the top of the box liner, an upper marginal part is similarly folded back to produce smaller envelope folds at each top corner which are similarly sealed against the liner box sides. The structure is of particular value in the context of water containment in a reinforced modal container because, at the time of installation, there is no requirement for field or hand sealed seams to be made in the liner tub part.

To install the preformed liner tub part **98**, it is folded out on the floor of the container after welding and protective painting of the modified front and back walls is completed and after an optional inch thick layer **32** of polystyrene insulation has been attached by adhesive over the complete interior of the container tank with foam rated adhesive to secure it to the underlying metal walls. The container tank sidewalls are coated with adhesive and the liner tub part **98** is pressed against the sidewalls to locate it in position. Once the liner tub part **98** is fixed in position, portions surrounding the apertures **100** at the container tank ends are positioned over the process wall flanges **76** in preparation for closing off the ends of the liner by installation of the process wall **64**. At the top wall of the container tank, as shown in FIG. **27**, a liner cap part **96**, cut to a size slightly smaller than the area of the top container wall is stuck against the top wall using adhesive. The liner tub part **98** has an upper section which is folded inwardly at the top of the tank so that a marginal portion **115** overlaps a marginal portion of the liner cap part **117**. Parts of the overlapping margins **115**, **117** are located on reinforcing bars **88** at the site of nuts **86**. At these sites, the overlapping margins **115**, **117** are punctured and threaded studs **127** are screwed into the underlying threaded apertures. Caulking compound **121** is applied between the overlapping margins **115**, **117** and an angle bar **123** is bolted over the join between the liner parts to provide a seal extending the full length of the overlap. It is important that the seal between the two liner sections is watertight because any escape of liquid along the seam could permeate behind the liner **96**, **98** and cause the walls **6**, **8** and the roof **12** to rust and deteriorate and cause water to collect and pool as a result of condensation.

Although the embodiments of the invention have been described in the context of converted reinforced intermodal containers, it will be appreciated that the illustrated support arrangements are applicable to other water treatment tanks not based on an intermodal tank conversion.

Other variations and modifications will be apparent to those skilled in the art. The embodiments of the invention described and illustrated are not intended to be limiting. The principles of the invention contemplate many alternatives having advantages and properties evident in the exemplary embodiments.

What is claimed is:

1. A tank for processing water, the tank having side and end walls, a roof and a floor, a tub part of a flexible liner for containing water to be processed mounted inside the tank, the tub part shaped to fit against the side walls, the end walls and the floor of the tank, the tank having a first reinforcing element adjacent the roof and extending across the width of the tank, a first suspension assembly mounted to the first reinforcing element, and a support assembly connected to the suspension assembly, the support assembly bearing against a part of the liner tub part fitted against the tank floor and supported by the tank floor, the interconnected support assembly and suspension assembly including an adjustment mechanism for adjusting a combined length of said interconnected support assembly and suspension assembly, whereby to render adjustable a pressure engagement between the bottom of said support assembly and the floor of the tank, the interconnected support assembly and suspension assembly configured for supporting a first item in the interior of the tank.

2. A tank as claimed in claim **1**, the reinforcing elements welded to the tank structure, the suspension assembly including a first fixture element fixed to the reinforcing element and a second fixture element in screw engagement with the first fixture element.

3. A tank as claimed in claim **1**, the tank having a plurality of such reinforcing elements adjacent the roof and extending across the width of the tank, the tank further comprising an insulating layer internally of the tank and extending over the roof except at the reinforcing elements.

4. A tank as claimed in claim **1**, the support assembly further including a generally vertical post.

5. A tank as claimed in claim **4**, the post having a resilient foot at a lower end thereof, the resilient foot bearing against a part of the liner tub part fitted against the tank floor and supported by the tank floor.

6. A tank as claimed in claim **4**, each of the suspension assemblies having an associated cap for bearing against a cap part of the liner at the roof, the cap having a contact area with the liner cap part substantially greater than the cross-sectional area of the post.

7. A tank as claimed in claim **4**, further comprising at least one support bracket mounted to at least one of the posts, the support bracket extending laterally from the post for supporting a water processing component at a level enabling operational interface between the water processing component and water when the water is contained in the liner tub part to a processing design level.

8. A tank as claimed in claim **4**, further comprising at least one support bracket mounted to at least one of the posts, the support bracket extending laterally from the post for supporting a utility component at a level above a design level for water to be processed in the tank.

9. A tank as claimed in claim **8**, further comprising a duct extending through the tank for housing utility components extending through the tank from one end to the other, the duct supported by the support bracket.

10. A tank as claimed in claim **1**, the tank being a converted, reinforced intermodal container.

11. A tank as claimed in claim **1**, further comprising a second reinforcing element adjacent the roof and extending across the width of the tank and a second suspension assembly mounted to the second reinforcing element, the second suspension assembly configured for suspending a second item in the interior of the tank.

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